Traditional, underfoot freeloaders

The common rat is an everyday companion that we know very little about

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The hopelessness of solving the rat menace is legendary. In the German folk tale, the Pied Piper lures the rats of Hamelin away by his music. On not being given the promised fee, the piper leads away the children of the town. What the story underscores, however, is the futility of ordinary methods used by municipal services to deal with infestation by rats.

The Journal of *Urban Ecology*, published by Oxford University Press, carries a review of the state of knowledge, or lack of knowledge, about this animal, which is known to flourish where human communities gather. In the context of increasing urbanisation and climate change, Michael H Parsons, Peter B Banks, Michael A Deutsch, Robert F Corrigan and Jason Munshi-South, from universities and the pest control industry in Australia and the US, stress the need to understand the habits of the city rat and examine how to focus research efforts on this area of importance.

Archaeological evidence and DNA studies indicate that rats took to colonising human habitations ever since humans changed from hunting-gathering to farming. This seems to have happened first in India, where the mouse family was a *commensal* (or living off humans, "sharing the table", and a pest) since 14,000 years ago. Glacial melting soon after led to migration of agriculture and the rodents migrated too. There is evidence that rats reached the Mediterranean basin about 10,000 years ago. Rats have travelled everywhere that humans went and ships carried them to lands where there were no rats. And everywhere they went, rats adapted and settled, often at the cost of local species.

The rise of cities, with large human aggregation, led to virtual "second cities" of rats being established, generally in burrows in the ground, crevices of masonry and in sewers and drainage. In 1982, the *Urban Ecology* paper observes, rodents were estimated to have cost the world's economy over US$ 300 billion, from food loss alone (that is, without the cost from disease, damage to livestock, structures, power lines, et al).

In comparison, the cost of air pollution has been recently assessed at US$ 225 billion. The paper observes that from 2000 to 2030, human population is expected to grow by 2.2 billion, with 2.1 billion being the growth in urban areas. This would create great resources for the proliferation of city rats. The paper further notes that climate change would result in longer active seasons for rats and for the different infectious organisms that they carry and spread.

In contrast to the speed with which the problem is increasing, the science of controlling rat populations, the risks and the costs, has not made progress, the paper observes. Poisons to exterminate them rapidly become ineffective, as rats learn to avoid them or become resistant. On the other hand, other species consume poisons, which enter the food chain. Even special programmes like *Integrated Pest Management* have failed, as the rat menace in large cities has become no less acute after the programmes were started. And in any case, as long as food and shelter are available, rat populations are found to rapidly recover.

An illustration depicting the Pied Piper of Hamelin folk tale.

The paper says that the reason administrations persist in traditional methods, in place of more effective management, is because there is great shortage of knowledge of the ecology and behaviour of the urban rat. The last serious studies are from the 1940s. Those involved releasing wild rats in the city or releasing unfamiliar rats among other rats, both of which involve risks and may violate current ethical norms. Later experiments with rats in captivity did not reflect reality, as rats are quick to acclimatise and adapt.

As it is difficult to work with rats in the wild, little attention has been paid by academics to the field. It was 40 years ago that behaviour-based rodent control was suggested and 30 years since the idea of studying the response of rats to scents, so that mating behaviour could be regulated, was mooted, the paper says. Over the years, more areas of "knowledge gap" have been identified, including the need for a systematic study of diseases harboured and transmitted by rats.

In the area of mitigating damage in agriculture, an approach of "ecology based rodent management" has been effective, the paper says. Those methods engage the community in concerted strategy, which includes timing of sowing or planting, the use of poisons and traps and maintaining hygiene. While these methods could be more effective if there were more knowledge about the behaviour of rats, there is just no effective strategy so far to deal with the urban rat, the paper says.

Logistics apart, a reason for the problem of rats having been neglected is that the problem is complex, the paper says. The complexity extends to the number of domains — social, ecological and economic — that are involved. Every strategy would impact these domains and call for trade-offs. An example of such "wicked problems" is the problem of environment pollution — control would impact livelihoods, prices, efficiency of the administration and may even exacerbate the problem itself.

Problems of this kind have no solutions and even success of their control is understood differently by different agencies. This is in contrast to the "tame problem", which has a technological solution.

The other difficulty is that the problem of rats is one that people do not like to talk about. Commercial establishments would like to brush it, literally, under the carpet. The paper cites a study, which says people so detest the topic of rats that speaking of them causes more depression than speaking of crime! And even where the problem is recognised, people would like to exterminate the accursed things rather than let them stay around for scientists to study.

Another thing is that people believe they know more about rats than they actually do. City dwellers see rats, day in and day out, and they think there is nothing more to know about them. What city dwellers see is just a few rats, the "bold or the desperate", which venture out of hiding, not the great many that are unseen, the paper says. And then, there is the multitude of research papers that feature rats, but laboratory-bred and not the ones we need to control.

The paper recognises that researchers would need to study rats in the real problem situations, typically where professional extermination agencies have been called in. Incentives would then have to be offered to get the agencies and the employers to take a longer view, rather than a quick and economical immediate solution. The paper proposes a systematic approach of identifying the problem, the stakeholders, the cost to each of them and then to design incentives to reduce conflicts of interest. And then to collaborate and coordinate, over a wide geographical span, so that we are able take in diverse views and generalise pest control in urban settings.

The problem is serious, difficult and growing and scientific neglect cannot continue. Else, in the (unlikely) event that we control global warming, we would find the benefits eroded, if not negated, by traditional, underfoot freeloaders.

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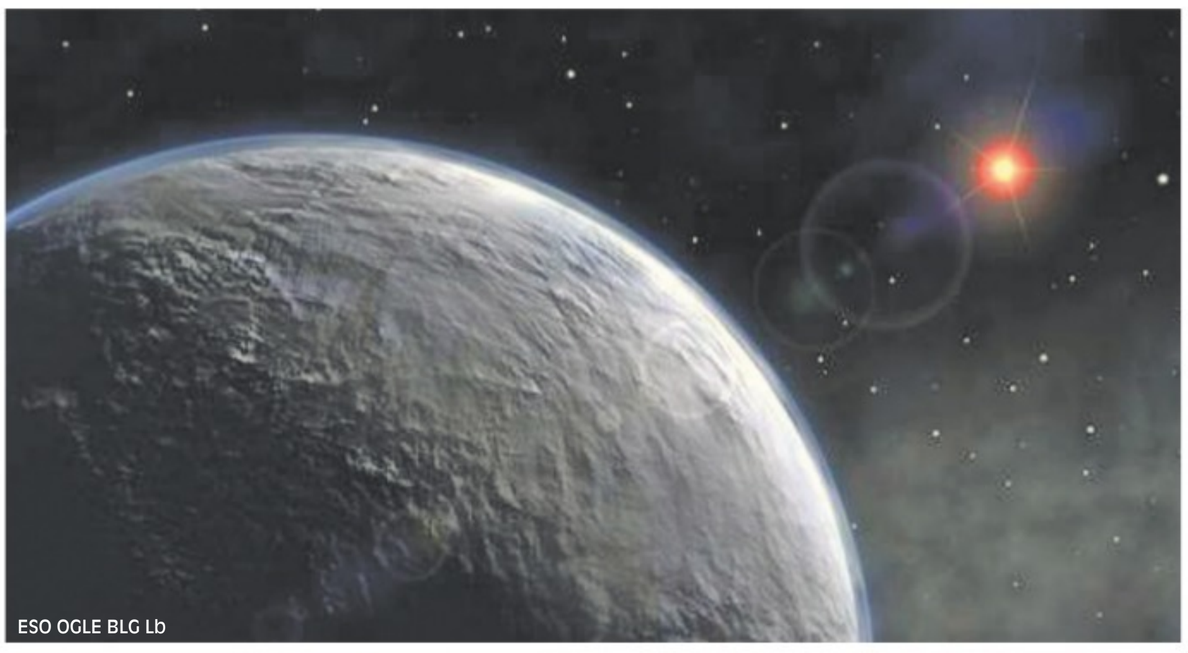
Rat-borne diseases

- **Leptospirosis:** Headache, fever, vomiting, rash and muscle aches. Could be fatal
- **Salmonella:** serious, sometimes fatal gastroenteritis
- **Rat-bite fever:** Fever, Vomiting, headache, muscle pains, joint pain and rash. Fatal in 10 per cent of untreated cases.
- **Bubonic plague:** Sudden onset of fever, headache, chills and weakness and one or more swollen, tender and painful lymph nodes. A few cells of the bacterium can be fatal. It can spread and kill large numbers very quickly.
- **Lymphocytic choriomeningitis:** Malaise, lack of appetite, muscle aches, headache, nausea and vomiting.

Awe-inspiring worlds

Here are seven of the most extreme planets ever discovered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CHRISTIAN SCHROEDER

Scientists recently discovered the hottest planet ever found — with a surface temperature greater than some stars. As the hunt for planets outside our own solar system continues, we have discovered many other worlds with extreme features. And the ongoing exploration of our own solar system has revealed some pretty weird contenders, too. Here are seven of the most extreme:

The hottest

How hot a planet gets depends primarily on how close it is to its host star — and on how hot that star burns. In our own solar system, Mercury is the closest planet to the sun at a mean distance of 57,910,000 km. Temperatures on its dayside reach about 430°C, while the sun itself has a surface temperature of 5,500°C.

But stars more massive than the sun burn hotter. The star HD 195689 -- also known as KELT-9 — is 2.5 times more massive than the sun and has a surface temperature of almost 10,000°C. Its planet, KELT-9b, is much closer to its host star than Mercury is to the sun.

Though we cannot measure the exact distance from afar, it circles its host star every 1.5 days (Mercury's orbit takes 88 days). This results in a whopping 4300°C — hotter than many of the stars with a lower mass than our sun. The rocky planet Mercury would be a molten droplet of lava at this temperature. KELT-9b, however, is a Jupiter-type gas giant. It is shrivelling away as the molecules in its atmosphere are breaking down to their constituent atoms — and burning off.

The coldest

At a temperature of just 50 degrees above absolute zero — -223°C — OGLE-2005-BLG-390Lb snatches the title of the coldest planet. At about 5.5 times the Earth's mass it is likely to be a rocky planet too. Though not too distant from its host star at an orbit that would put it somewhere between Mars and Jupiter in our solar system, its host star is a low mass, cool star known as a red dwarf.

The planet is popularly referred to as Hoth in reference to an icy planet in the Star Wars franchise. Contrary to its fictional counterpart, however, it won't be able to sustain much of an atmosphere (nor life for that matter). That is because most of its gases will be frozen solid — adding to the snow on the surface.

The biggest

If a planet can be as hot as a star, what then makes the difference between stars and planets? Stars are so much more massive than planets that they are ignited by fusion processes as a result of the huge gravitational forces in their cores. Common stars like our sun burn by fusing hydrogen into helium. But there is a form of star called a brown dwarf, which are big enough to start some fusion processes but not large enough to sustain them. 1-491201 b with the equally unpronounceable alias 2MASS J08230313-4912012 b has 28.5 times the mass of Jupiter — making it the most massive planet listed in NASA's exoplanet archive. It is so massive that it is debated whether it still is a planet (it would be a Jupiter-class gas giant) or whether it should actually be classified as a brown dwarf star. Ironically, its host star is a confirmed brown dwarf itself.

The smallest

Just slightly larger than our moon and smaller than Mercury, Kepler-37b is the smallest exoplanet yet discovered. A rocky world, it is closer to its host star than Mercury is to the sun. That means the planet is too hot to support liquid water and hence life on its surface.

The oldest

PSR B1620-26 b, at 12.7 billion years, is the oldest known planet. A gas giant 2.5 times the mass of Jupiter it has been seemingly around forever. Our universe at 13.8 billion years is only a billion years older.

PSR B1620-26 b has two host stars rotating around each other — and it has outseen the lives of both. These are a neutron star and a white dwarf, which is what is left when a star has burned all its fuel and exploded in a supernova. However, as it formed so early in the universe's history, it probably doesn't have enough of the heavy elements such as carbon and oxygen (which formed later) needed for life to evolve.

The youngest

The planetary system V830 Tauri is only two million years old. The host star has the same mass as our sun but twice the radius, which means it has not fully contracted into its final shape yet. The planet — a gas giant with three quarters the mass of Jupiter — is likewise probably still growing. That means it is acquiring more mass by frequently colliding with other planetary bodies like asteroids in its path making it an unsafe place to be.

The worst weather

Because exoplanets are too far away for us to be able to observe any weather patterns we have to turn our eyes back to our solar system. If you have seen the giant swirling hurricanes photographed by the Juno spacecraft flying over Jupiter's poles, the largest planet in our solar system is certainly a good contender. However, the title goes to Venus. A planet the same size of Earth, it is shrouded in clouds of sulphuric acid.

The atmosphere moves around the planet much faster than the planet rotates, with winds reaching hurricane speeds of 360 km/h. Double-eyed cyclones are sustained above each pole. Its atmosphere is almost 100 times denser than Earth's and made up of over 95 per cent carbon dioxide. The resulting greenhouse effect creates hellish temperatures of at least 462°C on the surface, which is actually hotter than Mercury. Though bone-dry and hostile to life, the heat may explain why Venus has fewer volcanoes than Earth.

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PLUS POINTS

Human lifespan debate

The lifespans of humans could continue to rise "far into the foreseeable future", according to two researchers who have dismissed the idea of a natural limit.

In October, researchers in the US argued that the chance of living beyond the age of 115 was incredibly small, based on an analysis of people over the age of 110 in four countries — the UK, US, France and Japan. It represented a "ceiling" or "barrier" to human life that would never be surpassed by the vast majority of people, they wrote in the journal, *Nature*. Jeanne Calment, a French woman who lived to 122, was simply an incredibly unlikely exception.

However, two other experts in the field have now hit back, claiming the idea that the historic, sharp rise in lifespan had recently hit a "plateau" was not supported by the available evidence. Bryan Hughes and Siegfried Hekimi, of McGill University in Canada, claimed in the same journal that the idea was "largely a product of the limited data available for analysis, owing to the challenges inherent in collecting and verifying the lifespans of extremely long-lived individuals".

And Hekimi said, "We just don't know what the age limit might be. In fact, by extending trend lines, we can show that maximum and average lifespans could continue to increase far into the foreseeable future."

Hekimi said it was "hard to guess" how long people might live in the future. "Three hundred years ago, many people lived only short lives," he said, "If we would have told them that one day most humans might live up to 100, they would have said we were crazy."

However, the original authors, led by Xiao Dong of the Albert Einstein College of Medicine in New York, stood by their findings. Replying to the McGill academics, they said projections of lifespan up to 2300 were "imaginative" but "not informative".

"We feel that our interpretation of the data as pointing towards a limit to human lifespan of about 115 years remains valid," they wrote.

Ian johnston/the independent

All in the bones

A new technique enabling archaeologists to distinguish between the bones of sheep and goats has been developed by researchers at the University of Sheffield, UK.

The methodology, developed by Lenny Salvagno and Umberto Albarella from the University's department of archaeology, could be a vital tool for researchers who study past human societies. Distinguishing between the bones of sheep and goats is a notorious challenge in zoo-archaeology. Currently, there are several ways in which archaeologists try to distinguish between the two species. Most of them rely on identifying morphological criteria, but these features are rather subjectively assessed, which means correct identification relies heavily on a researcher's experience and access to appropriate reference collections. Now, the research team has developed a new methodology based on measurements using a sample of more than 150 skeletons as a basis. This is based on morphometry — the translation of morphological characters into measurements, which are assessed in terms of their relative values. Not only does this method provide an additional tool for the distinction of the two species but, crucially, allows for much greater objectivity as the identification will be backed by metric diagrams that will explain the basis on which identifications were carried out. Salvagno, who led the research at the University of Sheffield, said, "The discovery of bones from sheep and goats can provide different insights in the cultural and economic evolution of humans. For example, the two animals may have been used for different products (like meat, wool, milk) and their relative frequencies, therefore, can inform us on which of these was particularly sought after by a certain cultural group."